

# ONTORAIL.ORG

A shared Railway Digital Knowledge Vault



Alain Jeanmaire, Lucian Emanuel Anghel, Olivier Boudou

- I. Motivation and Contexte
- II. Scope
- III. Solution Architecture
- IV. Element of integration
- V. Element of technique
- VI. What have we achieved?
- VII. What do we have to solve?



# Digital Modelling Standardisation & Digital Continuity in the Railway Sector

16<sup>th</sup> Semantic MediaWiki Conference  
Paris, September 25<sup>th</sup> 2019

Alain Jeanmaire



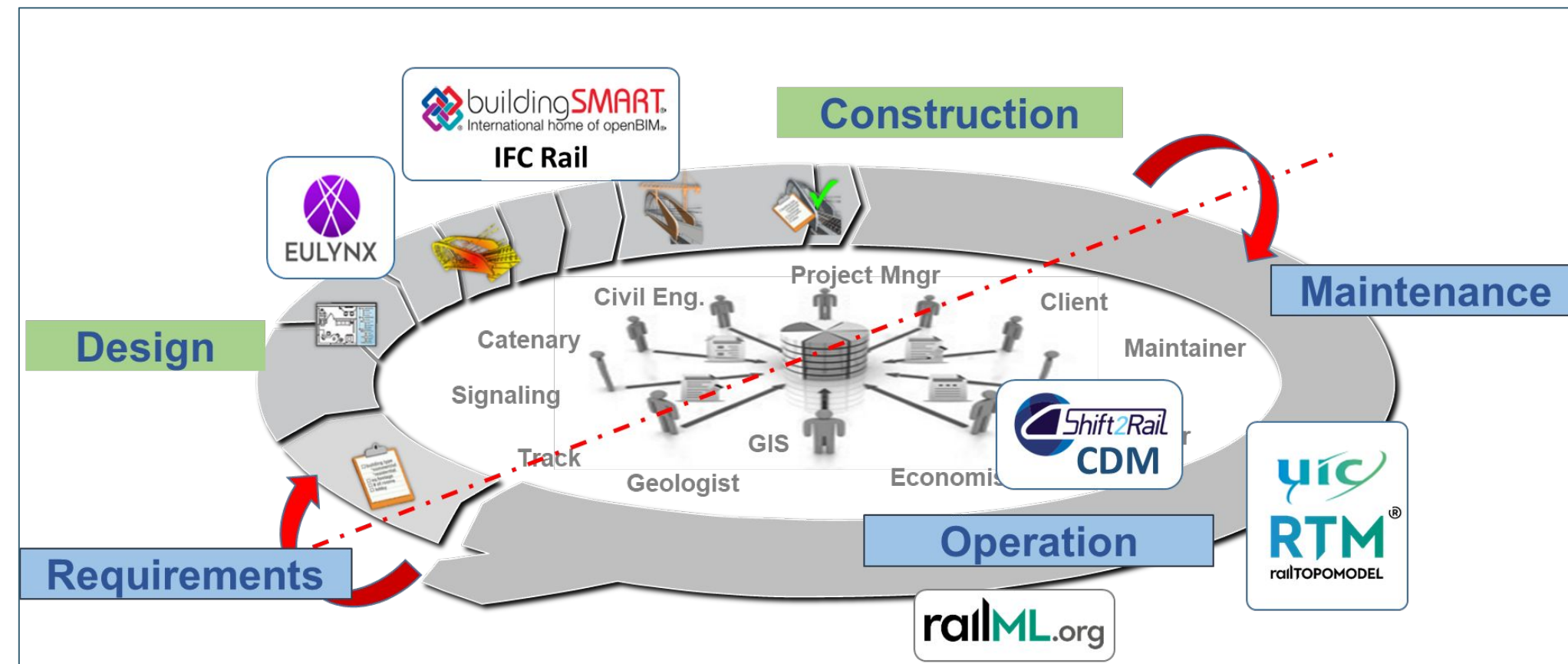
**Digital modelling Coordinator**

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[Alain.jeanmaire@outlook.com](mailto:Alain.jeanmaire@outlook.com)

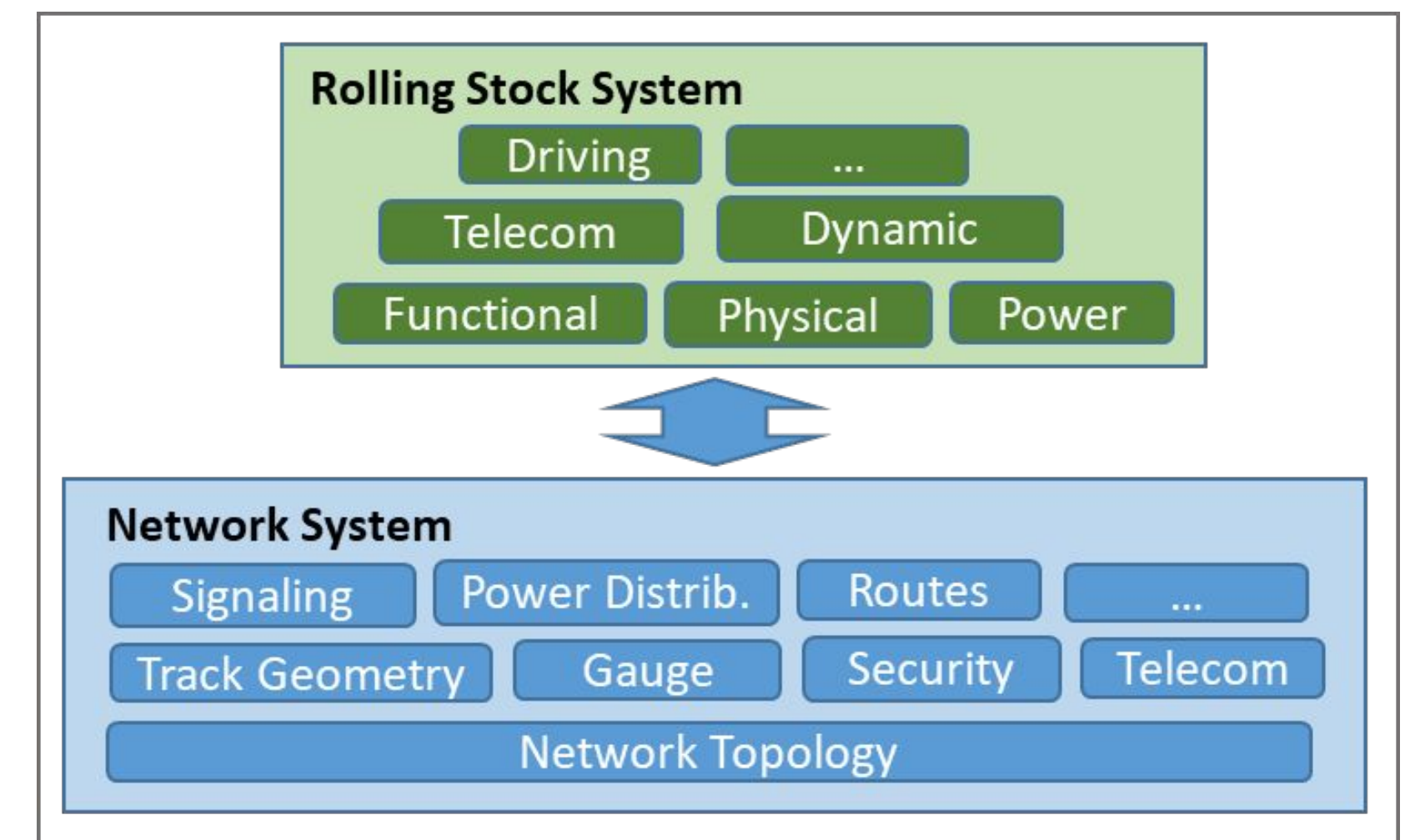
m

# Railway sector requires leverages for performance



Railway system design, construction and operation involve multiple technologies, actors, processes... working together in a continuous collaborative process for evolution

Customer requirements, evolution of technology, and search for performance are leading to a stronger integration of the Global Railway System.  
e.g. future Autonomous Train is an integrated solution involving all subsystems: Train, Infrastructure, and Traffic Management.

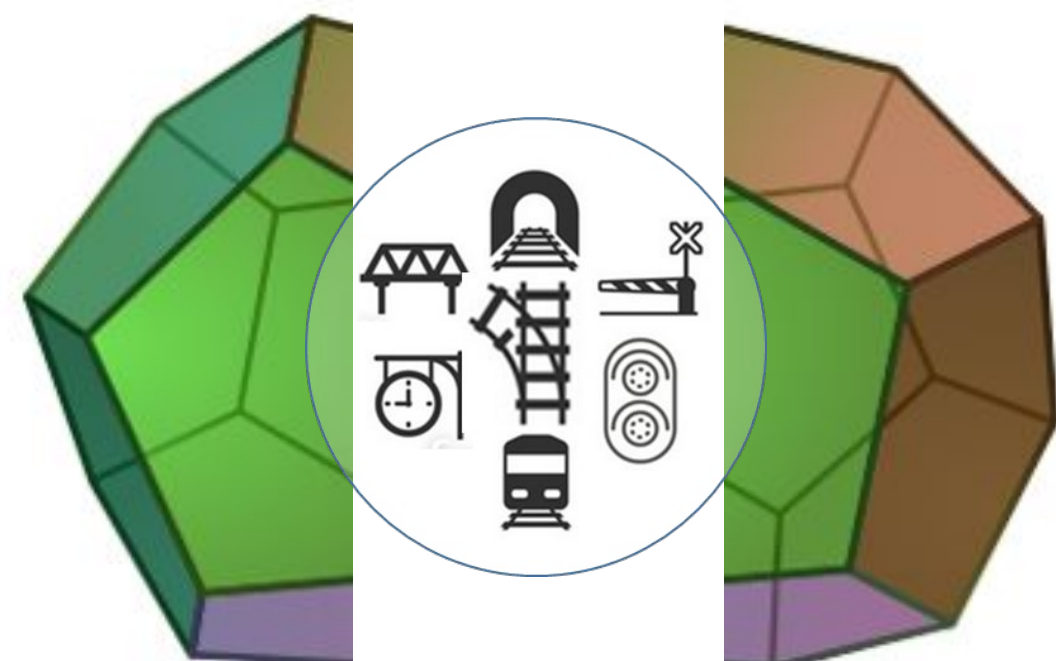


**Going for global performance requires to  
design, simulate, implement and operate the Railway System as a continuous whole.**

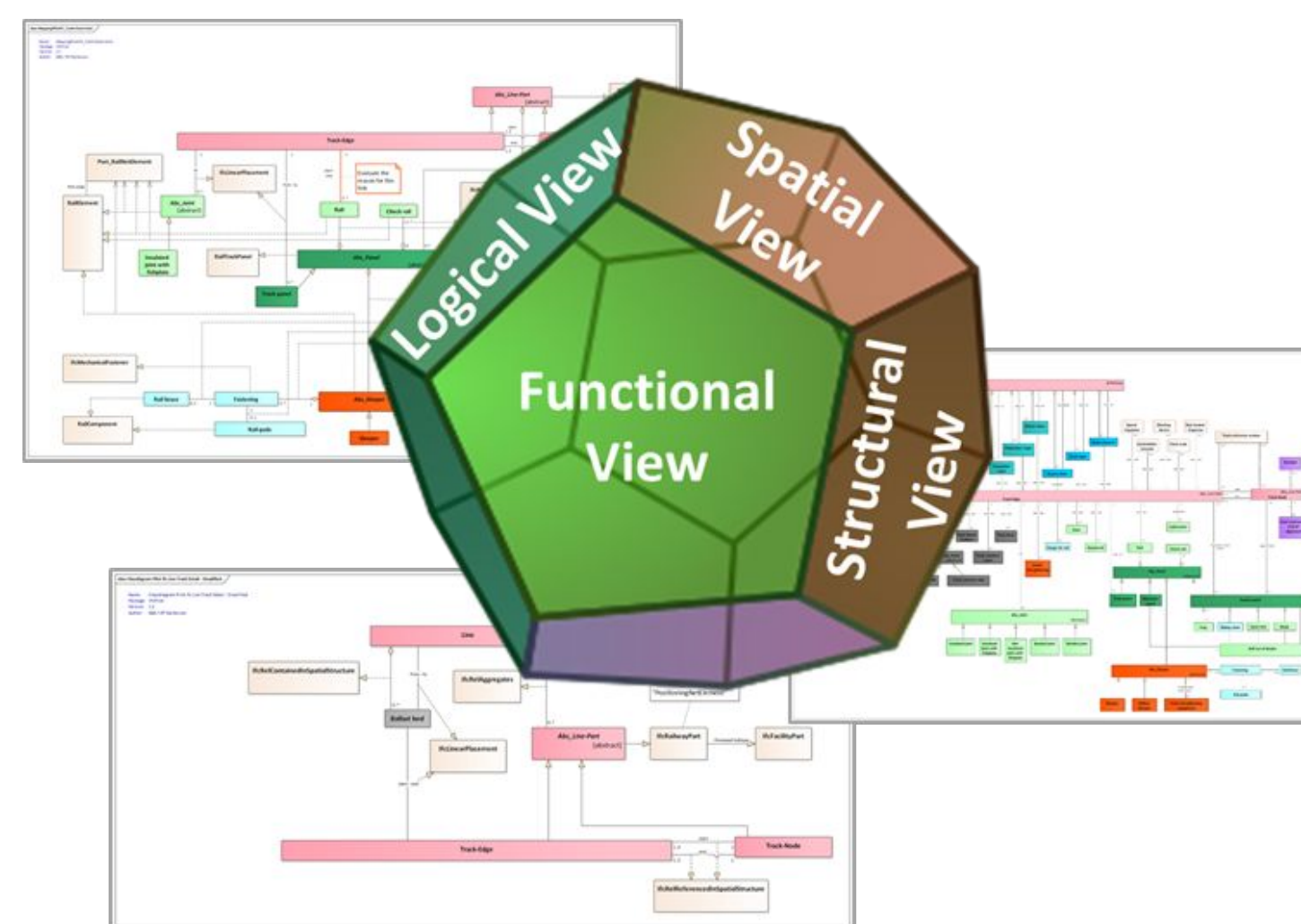
# Railway System is complex ...



... behaves as  
a whole



... with multiple sub-systems  
and dimensions,



... leading to several  
Projects for  
standardization



**RTM**<sup>®</sup>  
railTOPOMODEL

**EULYNX**

**Shift2Rail**  
CDM

**IFC Rail**

**railML.org**

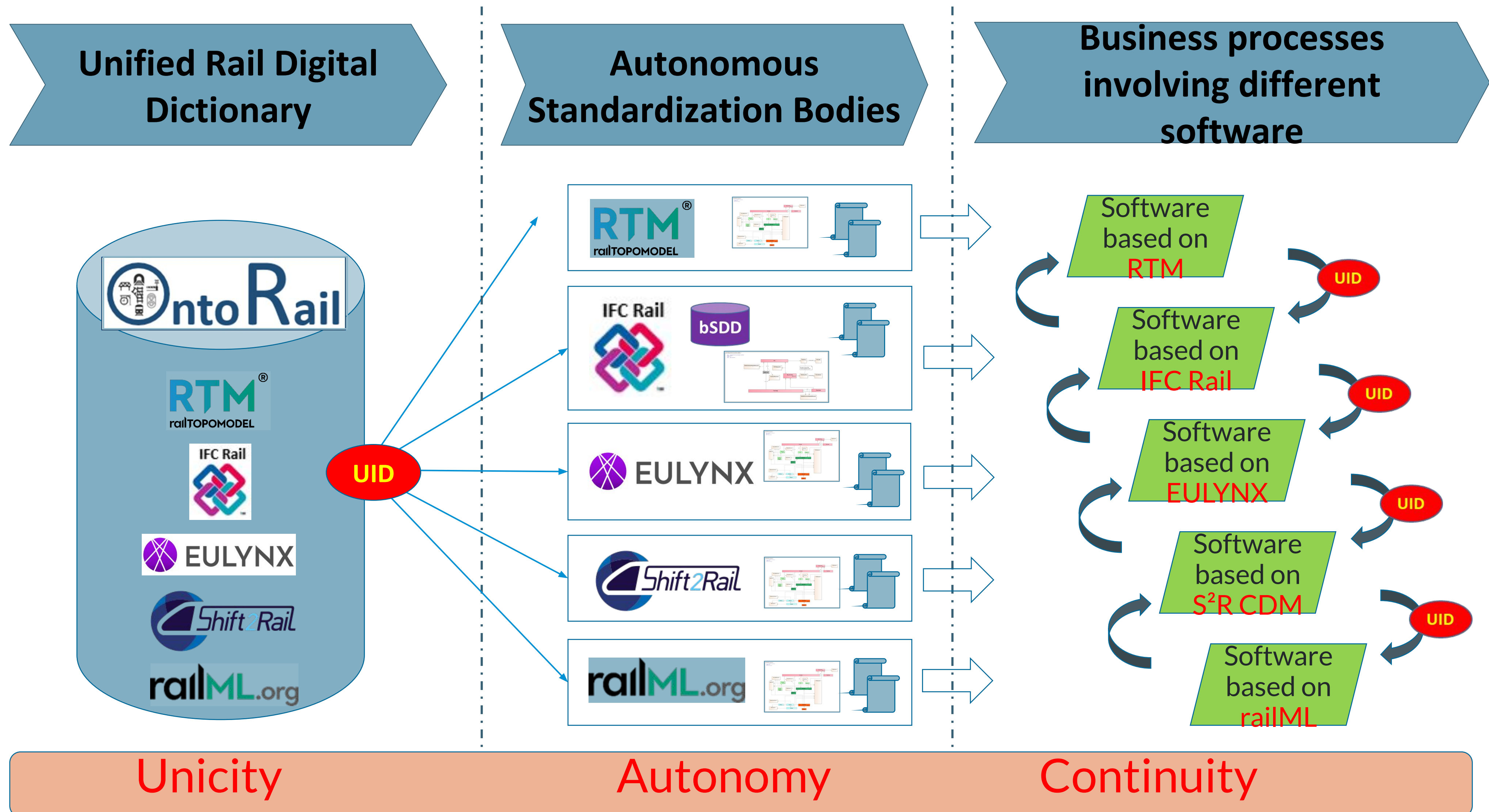
**But ... all projects for standardization describe the  
same System**





# Railway sector organizes Consistency to Leverage digital continuity

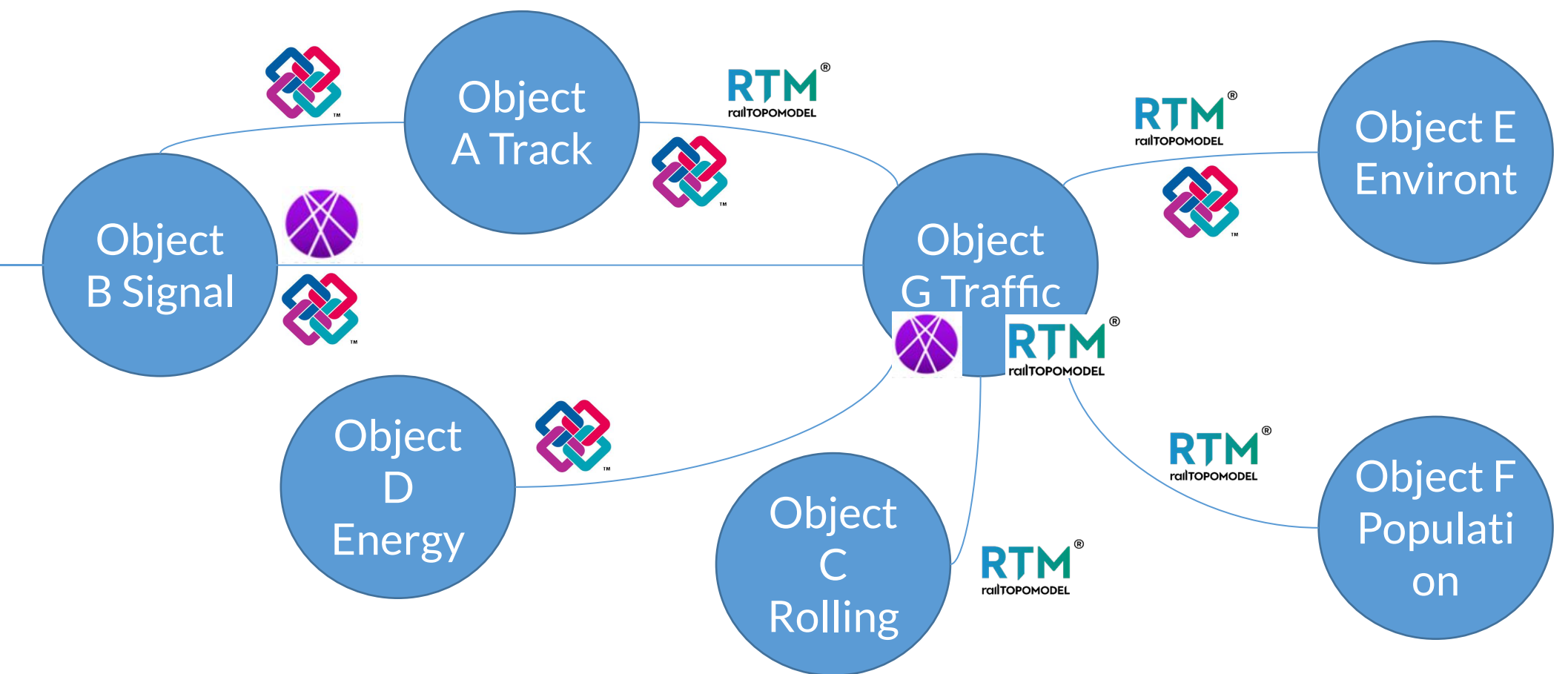
UIC leads the OntoRail project for a Common Digital Dictionary, involving all current projects for digital standardization and their stakeholders



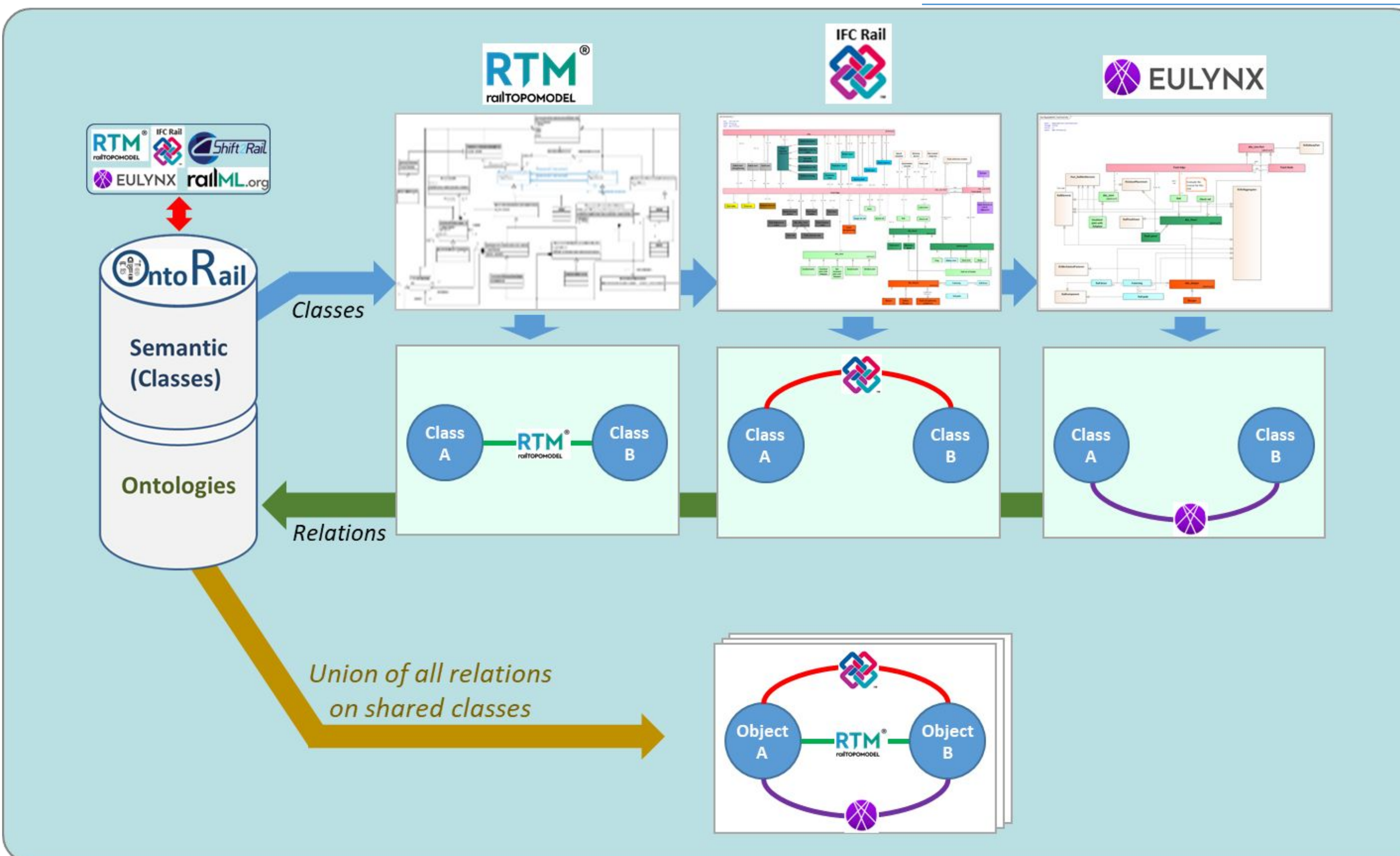
# Next step for digital continuity: Organize capability to combine standards

A business project willing to take benefit from standard models will have to **combine multiple 'parts'** from different standard models.

Example of a project requiring objects and dimensions managed by multiple standards

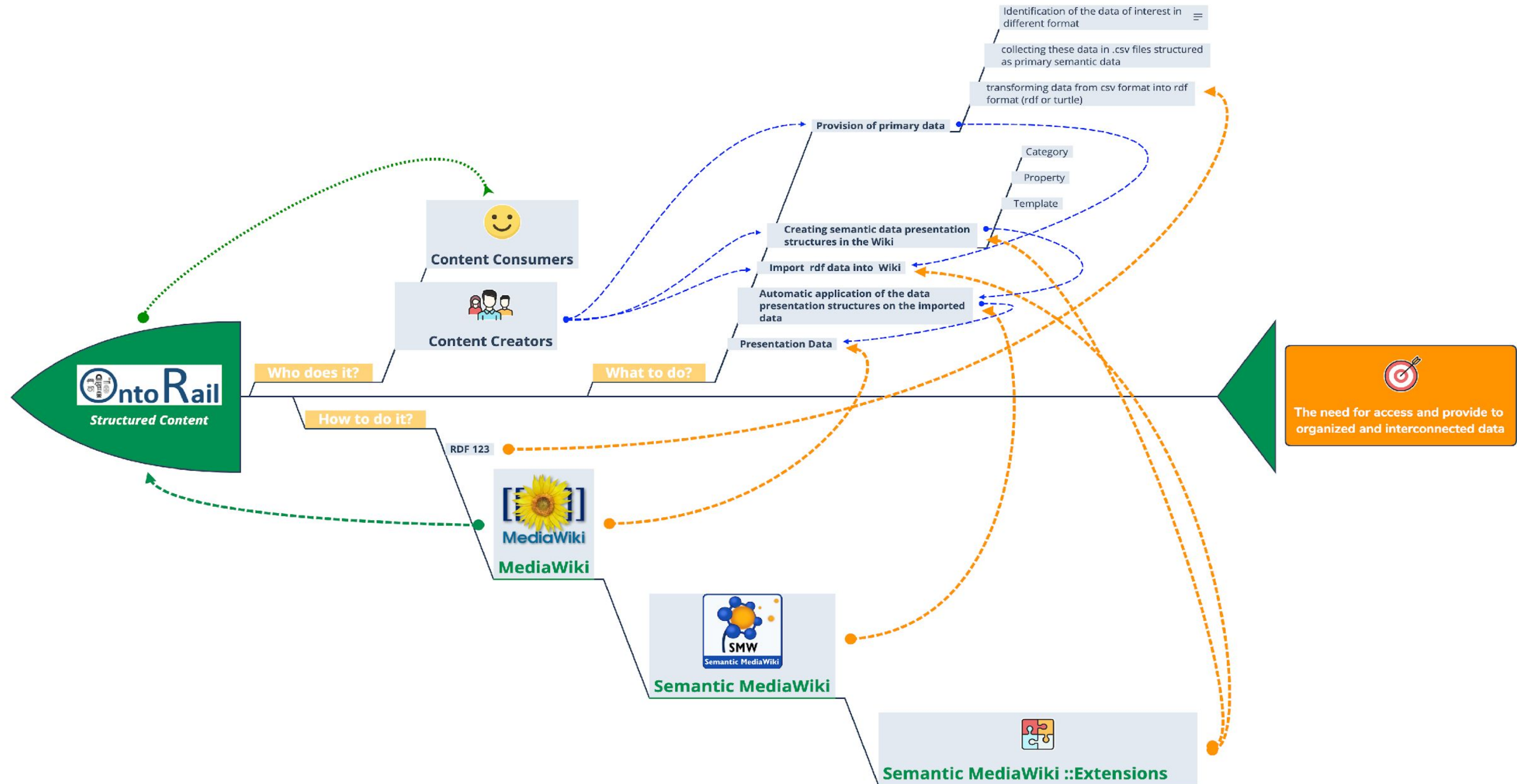


## Could Ontologies be the solution?



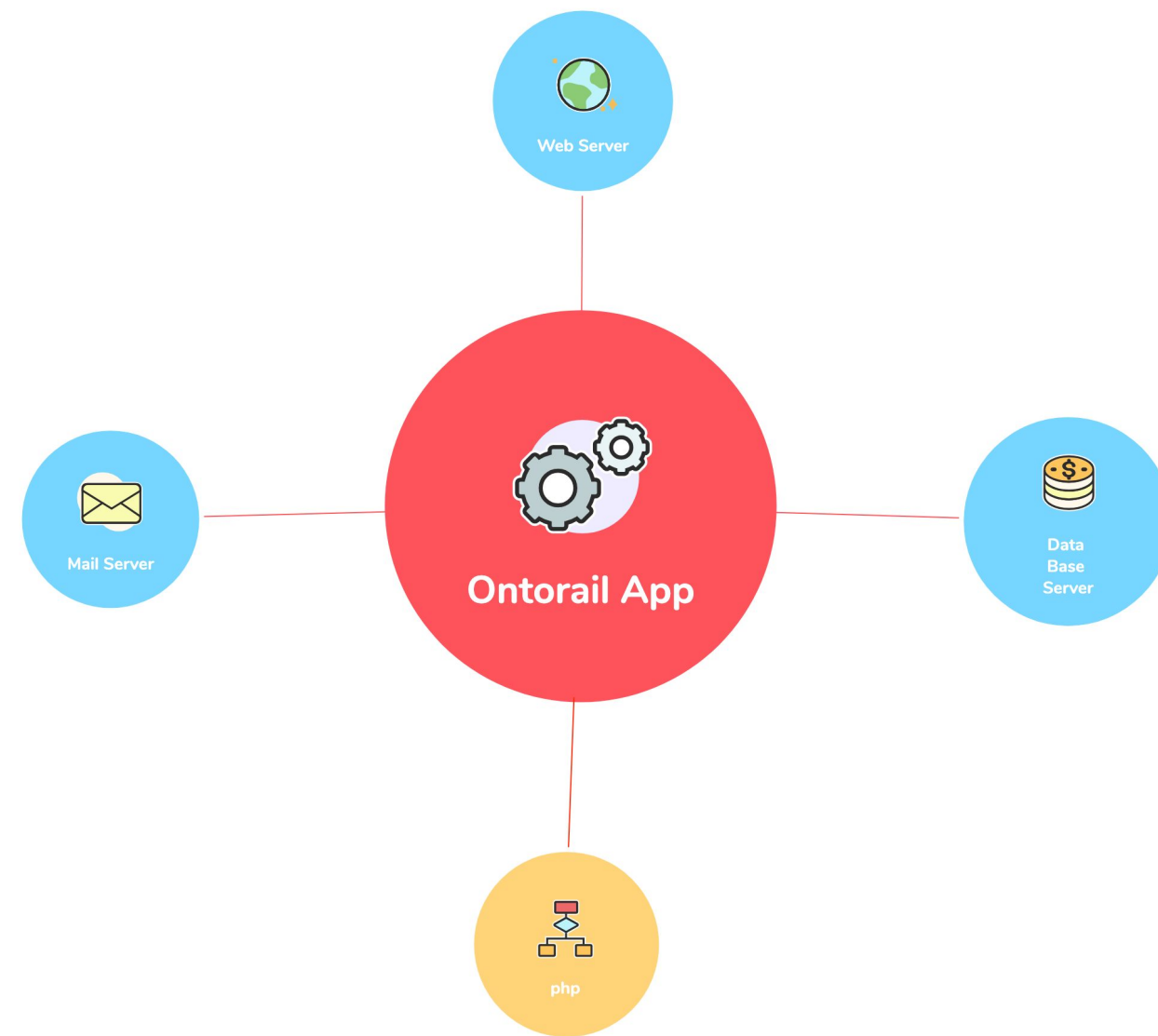
# Scope

8

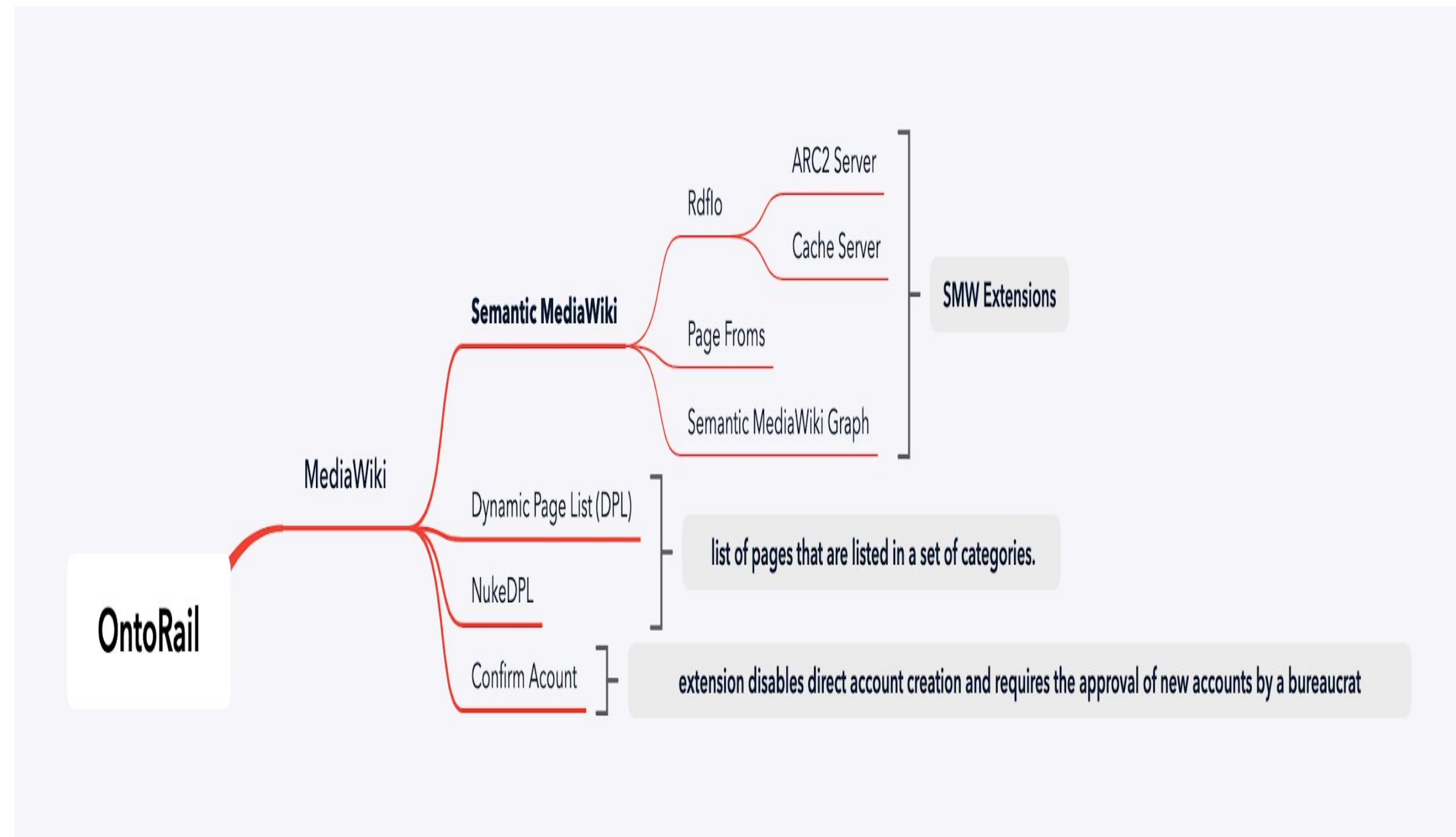


# Solution Architecture

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- Operating System: CENTOS 7.6 kvm
- ClamAV Daemon: ClamAV Virus Scanner
- PHP-FPM service for cPanel Daemons (the application-level PHP version manager)
- cPanel DNS Admin Cache
- Exim Mail Server
  - IMAP Server
  - Mailman
- FTP Server
- Apache Web Server
- MySQL Server



Principles

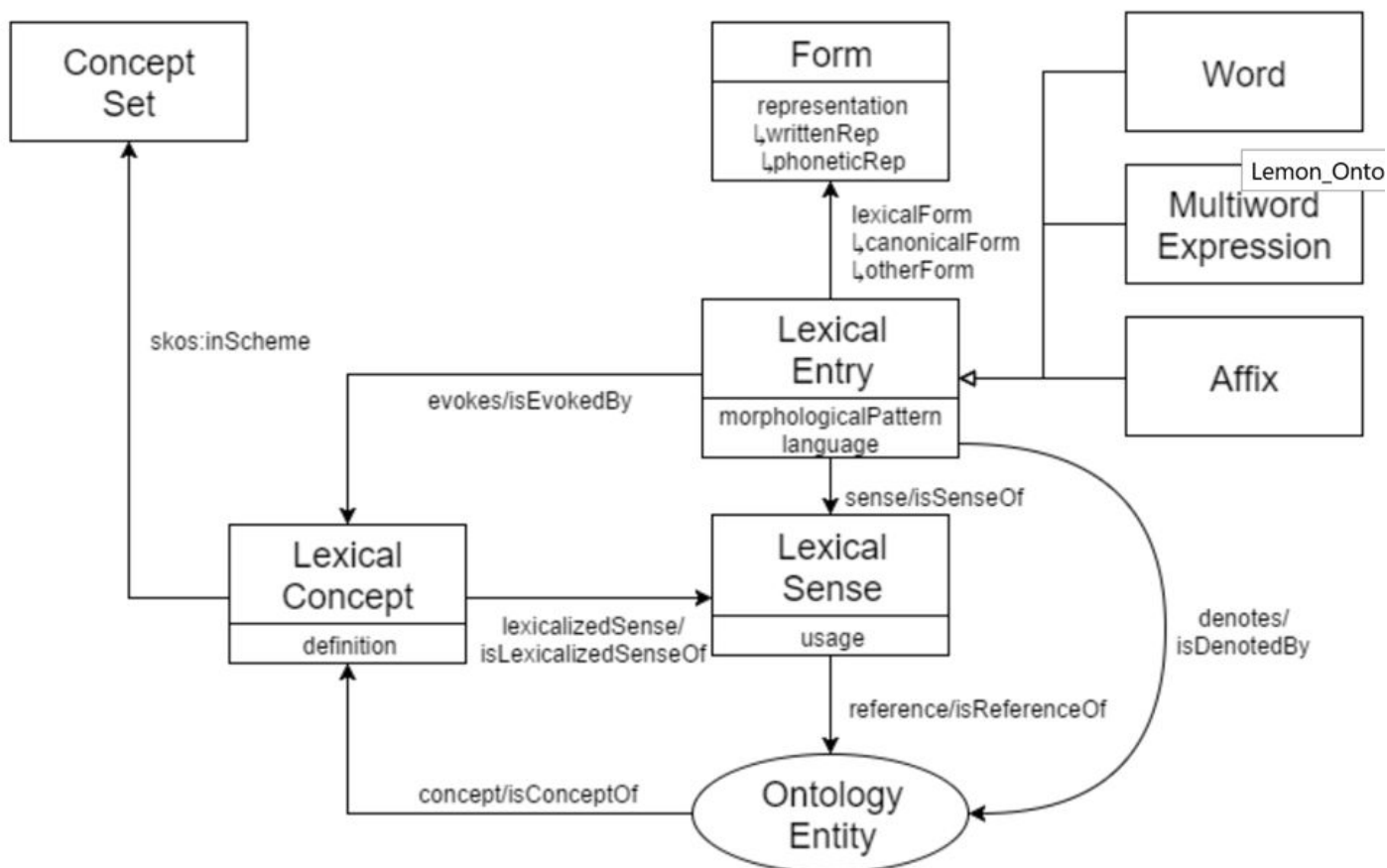


Figure 1 Lemon\_OntoLex\_Core.png

Wiki Example

Page

Discussion

Read

Edit with form

Edit

View history

More

Search UIC Wiki

# Signalling system

field_A	EULYNX 1.30
field_B	English

A signalling system performs three basic functions :

- train detection (localization);
- train spacing, e.g. by means of a block system;
- route protection (interlocking).

A signalling system uses signals to tell the driver what he should **not** do.

Category: Test class template

Facts

... more about "Signalling system" RDF feed

Performs

Train localization + Q , Train spacing + Q and Route protection + Q

Prop A

EULYNX 1.30 + Q

Prop B

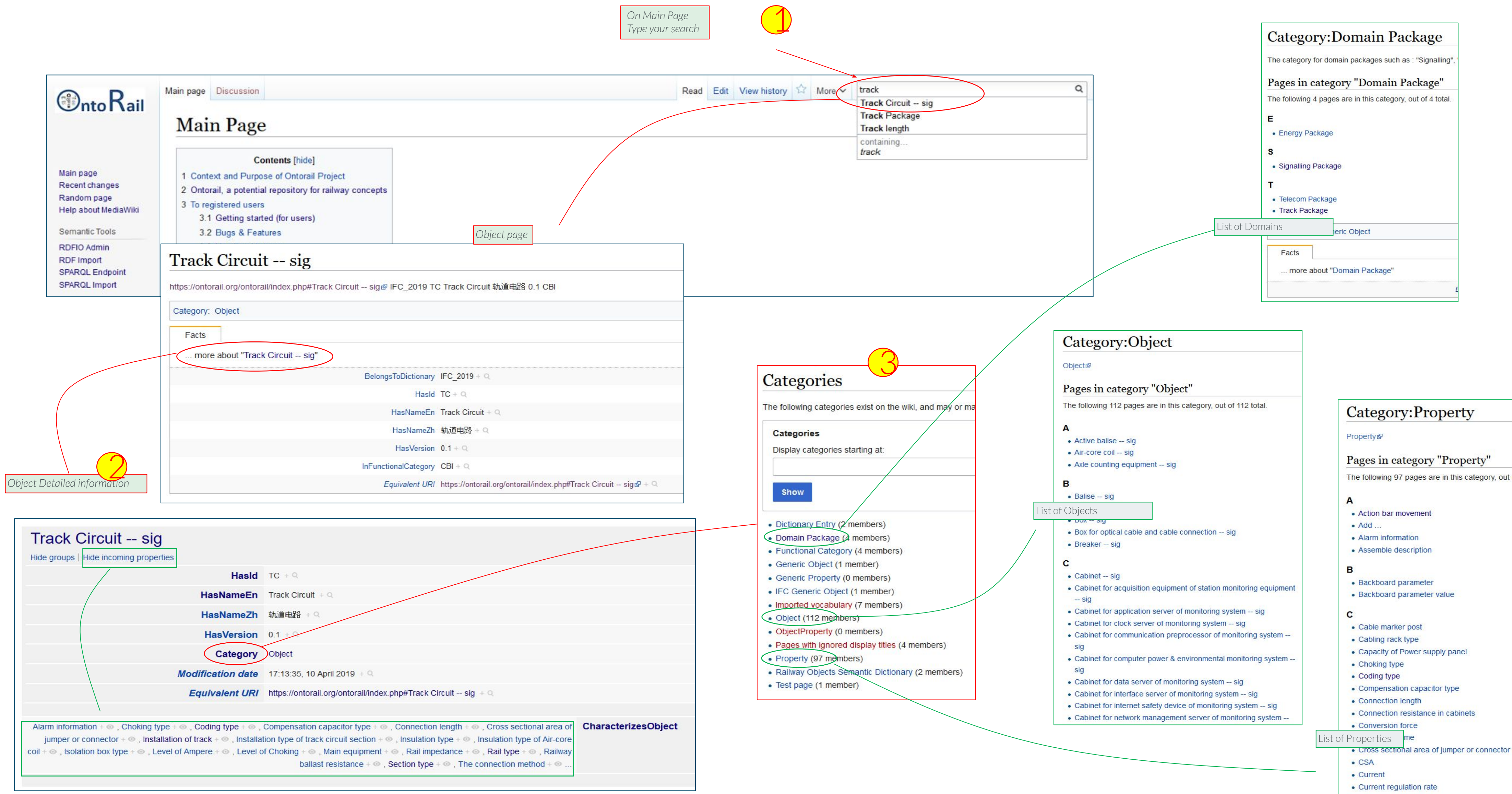
English + Q

Uses

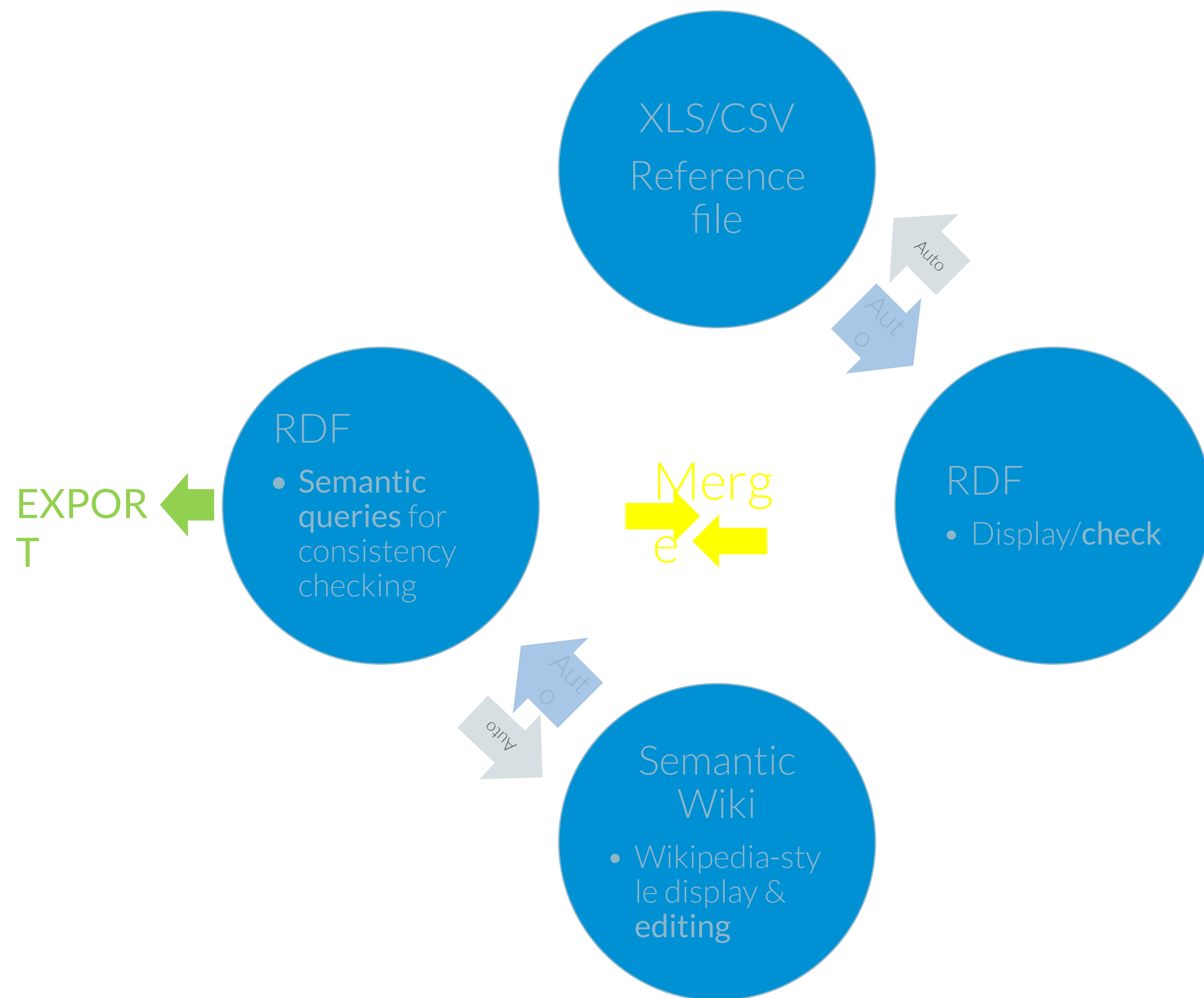
Signal + Q

```
-<rdf:RDF>
- <owl:Ontology rdf:about="https://uic-wiki.snoopy-cds.eu/mw28/index.php/Special:ExportRDF/Signalling_system">
  <swikt:creationDate rdf:datatype="http://www.w3.org/2001/XMLSchema#dateTime">2019-03-14T11:11:37+02:00</swikt:creationDate>
  <owl:imports rdf:resource="http://semantic-mediawiki.org/swikt/1.0"/>
</owl:Ontology>
- <swikt:Subject rdf:about="http://uic-wiki.snoopy-cds.eu/mw28/index.php/Special:URIResolver/Signalling_system">
  <rdf:type rdf:resource="http://uic-wiki.snoopy-cds.eu/mw28/index.php/Special:URIResolver/Category-3ATest_class_template"/>
  <rdfs:label>Signalling system</rdfs:label>
  <rdfs:isDefinedBy rdf:resource="https://uic-wiki.snoopy-cds.eu/mw28/index.php/Special:ExportRDF/Signalling_system"/>
  <swikt:page rdf:resource="https://uic-wiki.snoopy-cds.eu/mw28/index.php/Signalling_system"/>
  <swikt:wikiNamespace rdf:datatype="http://www.w3.org/2001/XMLSchema#integer">0</swikt:wikiNamespace>
  <swikt:wikiPageContentLanguage rdf:datatype="http://www.w3.org/2001/XMLSchema#string">en</swikt:wikiPageContentLanguage>
  <property:Performs rdf:resource="http://uic-wiki.snoopy-cds.eu/mw28/index.php/Special:URIResolver/Train_localization"/>
  <property:Performs rdf:resource="http://uic-wiki.snoopy-cds.eu/mw28/index.php/Special:URIResolver/Train_spacing"/>
  <property:Performs rdf:resource="http://uic-wiki.snoopy-cds.eu/mw28/index.php/Special:URIResolver/Route_protection"/>
</swikt:Subject>
```

# Element of integration



## Data Processing



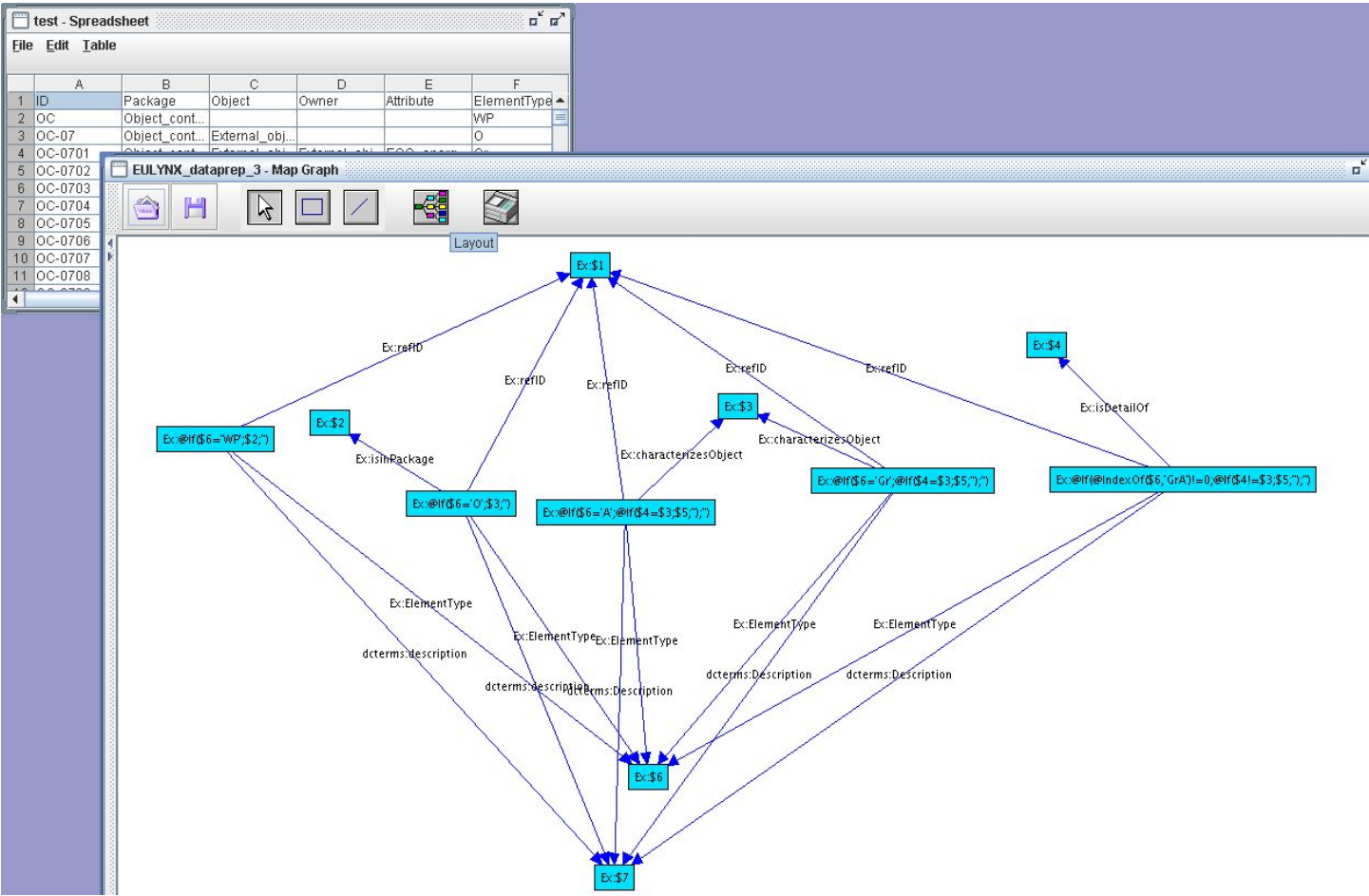
## From Excel sheets to Ontologies

- Test: transformation
  - Input: CSV file (Package, Objects, Attributes / Properties)
  - Output: Ontology (output: RDF file)
- The semantics currently exposed by the Excel files are typically
  - « Package contains Object »;
  - « Object has Attribute(s) » ;
  - « Attribute may contain Attributes » (analogous to a composite pattern in OOP)

# Element of technique

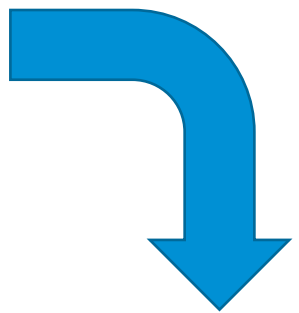
Data  
Processing

Excel sheet



Mapping graph

Using RDF123  
software



```
302 :Composite_route
303 <dct:terms:description>
304     "Composite main or shunt routes.
305     destination. If more than one ove
306 :ElementType "0" ;
307 :ID "R0-01" ;
:isinPackage "Route" .
```

RDF output file  
(here: N3 / Turtle  
format)

## Media Wiki Special pages for Semantic Tools

### Page tools

---

- |  |   |
|--|---|
| <ul style="list-style-type: none"><li>• <b>Change content model of a page</b></li><li>• Compare pages</li><li>• Export pages</li><li>• <b>Import pages</b></li></ul> | <ul style="list-style-type: none"><li>• <b>Mass delete by DPL query</b></li><li>• <b>Merge page histories</b></li><li>• <b>View deleted pages</b></li><li>• What links here</li></ul> |
|--|---|

### Page Forms

---

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>• Create a category</li><li>• <b>Create a class</b></li><li>• Create a form</li><li>• Create a property</li></ul> | <ul style="list-style-type: none"><li>• Create a template</li><li>• <b>Edit multiple pages</b></li><li>• Run query</li><li>• Start of form</li></ul> |
|---|--|

### RDFIO

---

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• <b>RDF Import</b></li><li>• <b>RDFIO Admin Page</b></li></ul> | <ul style="list-style-type: none"><li>• <b>SPARQL Endpoint</b></li><li>• <b>SPARQL Import</b></li></ul> |
|---|---|

### Semantic MediaWiki

---

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>• <b>Administrative and maintenance functions</b></li><li>• Browse wiki</li><li>• Export pages to RDF</li><li>• Processing error list</li></ul> | <ul style="list-style-type: none"><li>• Property label similarity report</li><li>• Search by property</li><li>• Semantic MediaWiki Graph</li><li>• Semantic search</li></ul> |
|---|--|

## RDFIO – Import function

Special page

Search uic\_wiki

RDF Import

Action: ☐ Import RDF from URL ☒ Paste RDF

Data to import:

```
Datenpunkt können zu einem Zeitpunkt nur Telegramme der gleichen SRS-Version gesendet werden. ;
:ElementType "A" ;
:ID "ET-1357" , "ET-1808" ;
:characterizesObject
  "RBC" ;
:isDetailOf "PODT_telegrams" .

<http://mybase#Local_operating_area_operating_display_element_(LOA_operating...)>
<dcterms:description>
  "Zuordnung von Bedienfunktionen zur Bedieneinrichtung einer oder mehrerer NB_Zonen, über
die Fahrdienstleiter und örtlichen Bediener miteinander kommunizieren. Falls sich bedienbare Elemente
innerhalb der NB_Zone befinden, sind diese durch eine entsprechende Bedieneinrichtung (um)stellbar,
sofern eine (Um-)Stellbarkeit vorgesehen wurde. Der Umfang hängt von der gewählten NB Art ab.
Weiterhin sind in der Bedieneinrichtung Elemente für die Kommunikation zwischen Fahrdienstleiter und
Bediener untergebracht. In diesem Objekt wird die Logik der Bedieneinrichtung abgebildet. Falls eine
Bedieneinrichtung Elemente aus mindestens zwei verschiedenen NB_Zonen enthält, ist eine Zuordnung der
Bedieneinrichtung zu den betreffenden NB Zonen erforderlich. Der Verweis auf Bedien Anzeige Element
führt zur Zuordnung der physischen Unterbringung. DB-Regelwerk Für die Planung existiert bei der DB AG
kein Regelwerk. Die Angaben finden sich meist im Erläuterungsbericht zum PT1." ;
:ElementType "O" ;
:ID "LO-02" ;
:isinPackage "Local_operating_area" .

:ID_Information_primary
<dcterms:Description>
  "Übergeordnetes, primäres Objekt der Informationsversorgung. DB-Regelwerk Beschreibung
im Erläuterungsbericht" ;
:ElementType "A" ;
:ID "OC-0708" ;
:characterizesObject
  "External_object_controller_(EOC)" .

:Is_driven_on
<dcterms:Description>
  "Angabe, ob der Fahrwegteil befahren wird (true) oder nicht (false)" ;
:ElementType "A" ;
:ID "ET-0664" ;
:isDetailOf "PODT_telegrams"
```

Data format: 

Turtle

Paste example data [RDF/XML format] [Turtle format] [Clear]

Submit

# Element of technique

All pages, imported from  
RDF

Special page

Search uic\_wiki

All pages

All pages

Display pages starting at:

Display pages ending at:

Namespace:

(Main)

☐ Hide redirects

Go

• AWSMagnetRef

• Abbreviation

• Acoustics duration offering/accepting the train

• Air telegram

• Alignment point

• Alignment point height

• Annotation

• Annotation general attributes

• AspectComponentName

• AssociatedTrainDetectionSection

• Automatic route setting (ARS)

• Autorisation to set a route

• AvailableAspect

• AvailableReadingDistance

• BTS

• Back board

• Basic object

• Block element general attributes

• Block normalising bell

• Cabinet line

• Comment

• Composite route

• Level crossing

• Level crossing system (LC system)

• Limited clearances

• LineOfWay

• Line kilometer

• Lock LC

• Main Page

• Main lock

• Map

• N/a

• NB Funktionalitaet NB R

• Norm drawing parameter general attributes

• Not traversed point

• OLEStructureRefDistance1

• OLEStructureRefNote2

• OperatedPosition

• Operating command "SBUE"

• Operating desk number

• Operating surface attachments

• Operating surface screen

• Operational point type

• Overlap specific

# Element of technique

SMW generated page by imported from  
RDF

## Alarm information

<https://ontorail.org/ontorail/index.php#Alarm information> IFC\_2019 Track\_Circuit --\_sig the information for failure decription None Alarm information 报警信息 0.1

Category: Property

Facts

... more about "Alarm information" RDF feed

BelongsToDictionary	IFC_2019
CharacterizesObject	Track Circuit -- sig
HasDefinitionEn	the information for failure decription
HasDefinitionZh	None
HasNameEn	Alarm information
HasNameZh	报警信息
HasVersion	0.1
Equivalent URI	<a href="https://ontorail.org/ontorail/index.php#Alarm information">https://ontorail.org/ontorail/index.php#Alarm information</a>

This page was last edited on 10 April 2019, at 17:13.

[Privacy policy](#) [About ontorail](#) [Disclaimers](#)

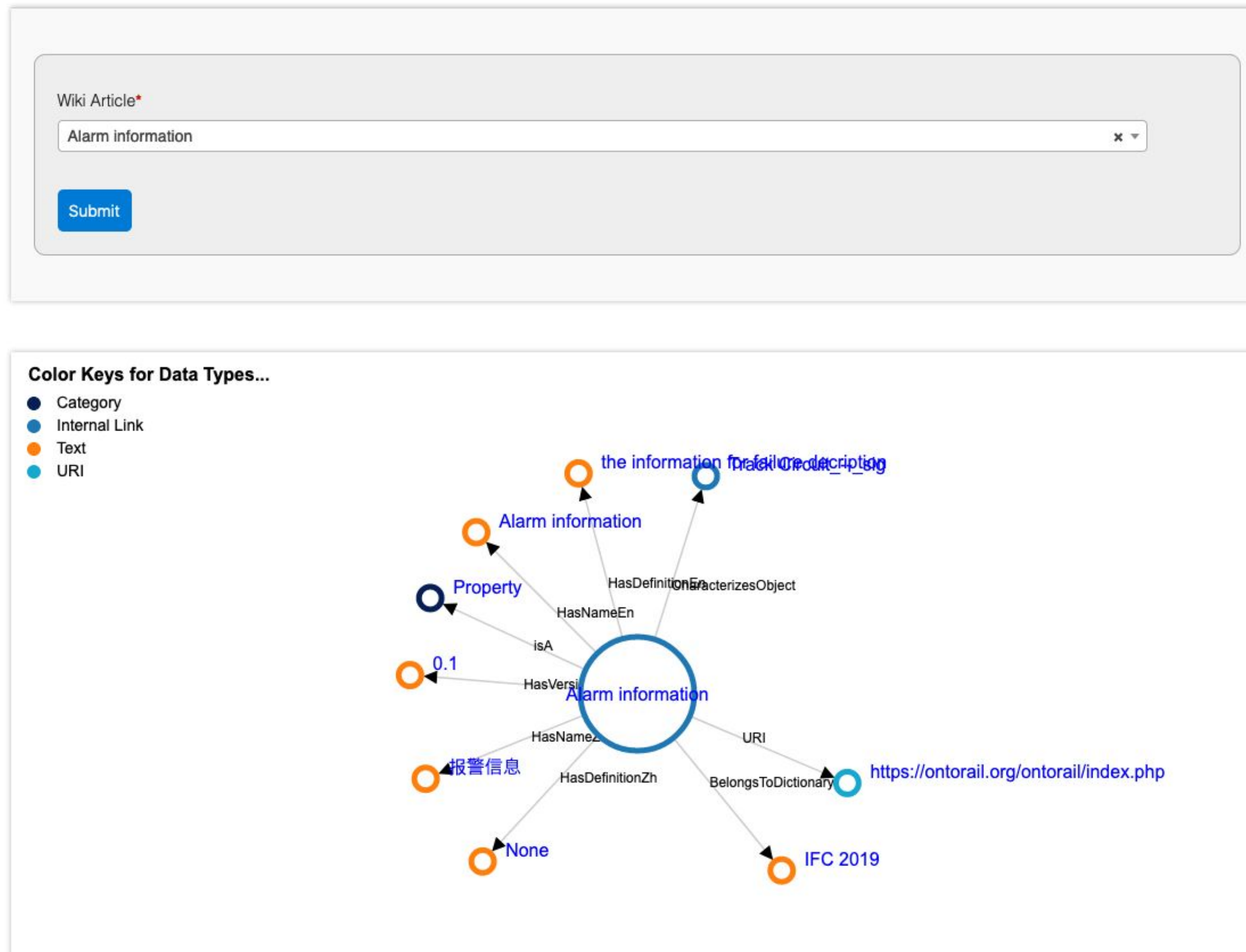


# Element of technique

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SMW page graph by imported from  
RDF

## Semantic MediaWiki Graph



# What have we achieved?

- A methodology has been created to transform the data from the CSV format into the RDF
- The instruments with which to do this have been identified
- The OntoRail server was created based on Mediawiki + Semantic Media WIKI
- The following extensions have been integrated into OntoRail server:
  - RDFIO
  - Semantic MediaWiki Graph
  - Page Forms
  - NukeDPL
  - DynamicPageList
  - Confirm User Accounts

# What do we have to solve?

- Update RDFIO extension to be able to:
  - generate attributes with multiple values
  - apply predefined templates over imported data
- Possibility to make a link between generated pages and Graph (based on Semantic MediaWiki Graph)
- Creation of a Rest API for data import from RDF files (in rdf or ttl format)
- Add modern Skin to Ontorail site (eg. Integration of Dokit platform)
- Identification and integration of new extensions useful for the Ontorail project

# What do we have to solve? (Big Thanks Lex 🥰)

21

- Update RDFIO extension to be able to generate attributes with multiple values

Page Discussion

TestObject

https://ontorail.org/ontorail/index.php/TestObject# IFC\_2019 AC Air-core coil 室外空心线圈 0.1 CBI

Category: Object

Facts

... more about "TestObject"

BelongsToDictionary IFC\_2019

HasId AC

HasNameEn Air-core coil

HasNameZh 室外空心线圈

HasVersion 0.1

InFunctionalCategory CBI

Equivalent URI https://ontorail.org/ontorail/index.php/TestObject#

age Discussion

Editing TestObject

This page supports semantic in-text annotations (e.g. "[Is specified as: World Heritage Site]") to build structured and queryable content provided by Semantic MediaWiki. For a comprehensive description on how to use annotations or the #ask parser function, please have a look at the getting started, in-text annotation, or inline queries help pages.

```
[[Equivalent URI:https://ontorail.org/ontorail/index.php/TestObject]]
[[BelongsToDictionary::IFC_2019]]
[[HasId:AC]]
[[HasNameEn:Air-core coil]]
[[HasNameZh:室外空心线圈]]
[[HasVersion:0.1]]
[[InFunctionalCategory:CBI]]
[[Category:Object]]
```

Page Discussion

TestObject

https://ontorail.org/ontorail/index.php/TestObject# IFC\_2019 AC Air-core coil 室外空心线圈 0.1

Category: Object

Facts

... more about "TestObject"

BelongsToDictionary IFC\_2019

HasId AC

HasNameEn Air-core coil

HasNameZh 室外空心线圈

HasVersion 0.1

InFunctionalCategory CBI and Block system

Equivalent URI https://ontorail.org/ontorail/index.php/TestObject#

Editing TestObject

This page supports semantic in-text annotations (e.g. "[Is specified as: World Heritage Site]") to build structured and queryable content provided by Semantic MediaWiki. For a comprehensive description on how to use annotations or the #ask parser function, please have a look at the getting started, in-text annotation, or inline queries help pages.

```
[[Equivalent URI:https://ontorail.org/ontorail/index.php/TestObject]]
[[BelongsToDictionary::IFC_2019]]
[[HasId:AC]]
[[HasNameEn:Air-core coil]]
[[HasNameZh:室外空心线圈]]
[[HasVersion:0.1]]
[[InFunctionalCategory:CBI | InFunctionalCategory:Block system]]
[[Category:Object]]
```

Commits on Sep 13, 2019		
Lex Sulzer	Picking up multivals in oldFacts	ba72b34
Lex Sulzer	Not deleting oldFacts	a35eca8
Lex Sulzer	Correctly importing multivals	f793335
Lex Sulzer	Typo	bc84348

Showing 2 changed files with 12 additions and 6 deletions.

Unified Split

8 classes/RDFIO\_SMWPageWriter.php

```
@@ -96,7 +96,7 @@ public function import( $wikiPages ) {
    // 11. If neither of 8-10 was done, add as new fact statements
    // -----
    $prop = $fact['p'];
-   if ( !array_key_exists( $prop, $oldFacts ) && !( $propTplIndex[$prop] ) ) {
+   if ( !array_key_exists( $prop,$fact['o'], $oldFacts ) && !( $propTplIndex[$prop] ) ) {
        $wikiTextUpdated = $this->addNewExplicitFact( $fact, $wikiTextUpdated );
    }
}

@@ -253,7 +253,11 @@ private function extractFacts( $wikiContent ) {
    $propName = $matches[1];
    $propVal = $matches[2];
    foreach ( $propName as $idx => $pName ) {
-   $facts[$pName] = array( 'property' => $pName, 'value' => $propVal[$idx], 'wikitext' => $wikiText[
+   $facts[$pName.$propVal[$idx]] = array(
+       'property' => $pName,
+       'value' => $propVal[$idx],
+       'wikitext' => $wikiText[$idx]
+   );
    }
    return $facts;
}
```

10 classes/RDFIO\_WikiPage.php

```
@@ -28,7 +28,10 @@ public function addEquivalentURI( $equivURI ) {
    public function addFact( $fact ) {
        if ( !is_null( $fact ) ) {
-       $this->factIndex[$fact['p']] = $fact['o'];
+       $this->factIndex[$fact['p'].$fact['o']] = array(
+           'p' => $fact['p'],
+           'o' => $fact['o']
+       );
        }
    }

@@ -79,8 +82,8 @@ public function getEquivalentUris() {
    public function getFacts() {
        $facts = array();
-       foreach( $this->factIndex as $prop => $obj ) {
-       $facts[] = array( 'p' => $prop, 'o' => $obj );
+       foreach( $this->factIndex as $str_po => $arr_po ) {
+       $facts[] = array( 'p' => $arr_po['p'], 'o' => $arr_po['o'] );
        }
        return $facts;
    }

@@ -108,4 +111,3 @@ private function categoryExists( $category ) {
    return in_array( $category, $this->categories );
}
}
```

# What do we have to solve?

- Update RDFIO extension to be able to apply predefined templates over imported data

## Fixing -- sig

https://ontorail.org/ontorail/index.php#Fixing -- sig IFC\_2019 FI Fixing 设备固定配件 0.1 Block system CBI Train control system

Category: Object

Facts

... more about "Fixing -- sig" 

RDF feed

BelongsToDictionary	IFC_2019	+ Q
HasId	FI	+ Q
HasNameEn	Fixing	+ Q
HasNameZh	设备固定配件	+ Q
HasVersion	0.1	+ Q
InFunctionalCategory	Block system , CBI and Train control system	+ Q
Equivalent URI	https://ontorail.org/ontorail/index.php#Fixing -- sig	+ Q

## Editing Fixing -- sig

This page supports semantic in-text annotations (e.g. "[[Is specified as::World Heritage Site]]") to build structured and queryable content provided by Semantic MediaWiki. For a comprehensive description on how to use annotations or the #ask parser function, please have a look at the [getting started](#), [in-text annotation](#), or [inline queries](#) help pages.

```
[[Equivalent URI::https://ontorail.org/ontorail/index.php#Fixing_--_sig]]
[[BelongsToDictionary::IFC_2019]]
[[HasId::FI]]
[[HasNameEn::Fixing]]
[[HasNameZh::设备固定配件]]
[[HasVersion::0.1]]
[[InFunctionalCategory::Block system]]
[[InFunctionalCategory::CBI]]
[[InFunctionalCategory::Train control system]]
[[Category:Object]]
```

## Fixing -- sig

Fixing is part of of Dictionary IFC\_2019 Fixing is in Functional CategoryCBI of the.

https://ontorail.org/ontorail/index.php#Fixing -- sig IFC\_2019 FI Fixing 设备固定配件 0.1 Block system CBI Train control system

Category: Object

Facts

... more about "Fixing -- sig" 

RDF feed

BelongsToDictionary	IFC_2019	+ Q
HasId	FI	+ Q
HasNameEn	Fixing	+ Q
HasNameZh	设备固定配件	+ Q
HasVersion	0.1	+ Q
InFunctionalCategory	Block system , CBI and Train control system	+ Q
Equivalent URI	https://ontorail.org/ontorail/index.php#Fixing -- sig	+ Q

## Editing Fixing -- sig

This page supports semantic in-text annotations (e.g. "[[Is specified as::World Heritage Site]]") to build structured and queryable content provided by Semantic MediaWiki. For a comprehensive description on how to use annotations or the #ask parser function, please have a look at the [getting started](#), [in-text annotation](#), or [inline queries](#) help pages.

```
{
  Name      = Fixing
  Zh Name   = 设备固定配件
  Version   = 0.1
}

Fixing is part of [[Category:Object]] of Dictionary [[BelongsToDictionary::IFC_2019]]
Fixing is in Functional Category[[InFunctionalCategory:: Block system | CBI | Train control system ]] of the [[Category:Object]].

[[Equivalent URI::https://ontorail.org/ontorail/index.php#Fixing_--_sig]]
[[BelongsToDictionary::IFC_2019]]
[[HasId::FI]]
[[HasNameEn::Fixing]]
[[HasNameZh::设备固定配件]]
[[HasVersion::0.1]]
[[InFunctionalCategory::Block system]]
[[InFunctionalCategory::CBI]]
[[InFunctionalCategory::Train control system]]
[[Category:Object]]
```

## Editing Template:Infobox IFC 2019

This page is not enabled for semantic in-text annotations due to namespace restrictions. Details about how to enable the namespace can be found on the [configuration](#) help page.

```
<noinclude>This is a greatly simplified adaptation of the template from [[wikipedia:{{FULLPAGENAME}}]].

{| style="border: 1px solid; width:25em; float: right; font-size: 90%;
-
colspan="2" style="text-align: center; "| '''{{Name}}'''
-
| [[Property:HasNameEn | Name]]
| [[Name:{{{HasNameEn}}}]]
-
| [[Property:HasNameZh | Zh Name]]
| [[Zh Name:{{{HasNameZh}}}]]
}

<!-- now some annotations that don't appear in the template -->
<includeonly> [[Category:Object]] [[BelongsToDictionary::IFC_2019| ]] </includeonly>
<noinclude> [[Category:Object]] </noinclude>
```

# Thank you for attention

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